exceed the rate of 120 miles an hour, but this is only in puffs of a few seconds' duration, as the total movement of the wind for a whole hour rarely exceeds 60 miles. Now, wind pressure is usually estimated at 2 pounds per square foot of surface when blowing perpendicular to that surface with a velocity of 20 miles per hour, 8 pounds for 40 miles, and 18 pounds for 60 miles, the pressure increasing as the square of velocity. [It will be observed that during the Gulf storm of September 26–27, 1906, the wind maintained a velocity of 70 miles at Pensacola for a whole hour.] If we assume the highest velocities and calculate the pressures by this rule, we should expect few ordinary houses to resist them. But in the wake of a storm, a study of the structures which fail and of those which resist is generally calculated to surprise an observer far more by the apparently weak ones which have resisted the winds than by the apparently substantial ones which have failed. And when those which have failed are examined, it will be found, almost invariably, that failures are due to unstable foundations or to lightly attached roofs. In fact, it may be taken as a measure of the force of hurricane winds that the frame of any ordinary house will resist them. But the foundations must be firm and the roofs fairly well framed and attached. In new houses, by the use of wooden ceilings instead of plastering, and a few angle irons and bolts, one can easily have a structure like a double box, which could be almost rolled over without injury. Old houses, badly constructed and with poor foundations, may be easily preserved by a few stout braces or inclined props on sides opposite the wind. In short the wind of a cyclone by itself seldom works serious injury. It is only where it has the water as an ally and accumulator of its forces that its ravages are great. When a hurricane passes inland it soon becomes little more than a bit of very bad weather. Its great instrument of destruction is the so-called tidal wave or storm tide, or, more properly, storm wave, which is raised by it and which submerges the low land of the coast. Below the limit to which these waves rise is the zone of danger in a hurricane; above it is the zone of easily attained safety.

How far this danger line may extend above ordinary high water depends so largely upon local configuration of coasts that it is only to be determined for any locality by observation. Unfortunately reliable measurements and data upon this point are rare and difficult to obtain. Popular accounts are always exaggerated, being largely based upon the action of surface billows, which send water and drift far above the general level of the storm wave. A vessel, for instance, drawing eight feet may be carried by successive billows across a marsh submerged only four feet beneath the general level. I have read accounts of combined storm waves and high tides rising ten or twelve feet above ordinary high-water mark, but when the action of billows is eliminated and careful measurements are made, the highest record of a storm tide above ordinary high water which I have been able to find anywhere is 8.2 feet. This limit was reached at Fort Pulaski, Ga., in the great gale of August 27, 1893, which broke all records in the height of its waters, in the destruction of life and property, and in the measured velocity of its wind, which at Charleston, for a few moments, exceeded 120 miles an hour. As this gale is one of great interest, the reader is referred to the records published in the MONTHLY WEATHER REVIEW for October, 1893, page 297.

The following table shows the rise of the tide caused by this hurricane, and for comparison, also, the highest storm tides ever recorded at several Gulf, Atlantic, and Lake ports, as shown by records of the U. S. Coast Survey and Engineer offices.

Highest storm tides at various points.

Locality.	Date.	Height of tide.	Moon's age.
		Feet.	*Days.*
Boston, Mass.	April 16, 1851	5.3	15
Sandy Hook, N. J.	September 10, 1889	3.9	14
Fort Monroe, Va.	March 10, 1846	5.1	12
South Island, S. C.	October 13, 1893	6.8	2
Fort Sumter, S. C.	August 27, 1893	6.4	14
Fort Pulaski, Ga.	August 27, 1893	8.2	14
Mobile, Ala.[3]	October 2, 1893	7.0	20
Buffalo, N. Y.	January 9, 1889	8.0	6
Duluth, Minn.	September 28, 1895	4.0	9

The plane of reference is ordinary high water, and the age of the moon is given in each case to indicate whether the storm tide coincided with the normal high tides, which occur at all Atlantic ports about each full or new moon. There is no tide at Lake ports, and but little in the Gulf.

From the above we see that the serious ravages are committed by the water rather than by the wind, and that they are confined to a narrow zone seldom, if ever, reaching more than eight or nine feet above the plane of ordinary high water. Above that zone ordinarily well built houses will easily resist the winds if the house and the roof are securely framed together and the foundations are stable. If there are weak points, even cheap and ordinary props or braces which can be improvised rapidly, are very effective in breaking up vibrations and resisting the pushes and shakes of the wind. Within the zone of danger from water, the dash of the waves and the tendency of the water to lift and float all wooden structures must be provided for. The limits of this article do not permit a full discussion of the magnitudes of these dangers and the various means by which they may be met, but it may be said briefly that pile foundations, or the equivalent, posts framed into buried timbers, are at once cheap and efficient.

[3] The tide of September 27, 1906, at Mobile, is reported to have been about one foot higher than that of 1893.—*E. B. G.*

WEIGHT OF SLEET ON SUSPENDED WIRES, CABLES, AND BRIDGES.

The breakage of telegraph lines and cables by the weight of the accumulated sleet, ice, and snow led us some years ago to ask that observers send to the MONTHLY WEATHER REVIEW some observations on the weight of sleet actually observed in ordinary and extreme cases. We now renew the request. Please state the size of wire, or cable, and the weight of ice per linear foot.—*C. A.*

RAINY OR SNOWY WEATHER AS FORETOLD BY HALOS.

It is a well-known fact that rain, snow, and general storms are frequently preceded by the appearance of halos, and especially simple circles around the sun or moon. The relation between these phenomena has been carefully studied in Europe, but I know of nothing especially bearing on this subject in America. Would not many of our observers, both regular and voluntary, do well to look over their past records, and tabulate the dates and hours on which halos were observed, more especially the 22-degree and 45-degree circles around the moon and the sun, with a statement of the weather that followed twenty-four hours later? Doubtless the halo will be a much better guide in predicting the weather in some places than in others.—*C. A.*

MONTHLY REVIEW OF THE PROGRESS OF CLIMATOLOGY THRUOUT THE WORLD.

By C. FITZHUGH TALMAN, U. S. Weather Bureau.

PUBLICATION OF CLIMATOLOGICAL RETURNS FOR THE BRITISH COLONIES.

It appears from a recent report of the British Meteorological Committee[1] that a proposition to provide for the publication, in convenient and accessible form, of the abundant climatological data now accumulating in nearly all the British colonies was recently considered by the Committee, and rejected on the score of expense. Following are extracts from a correspondence on this subject that past between the Colonial Office and the Treasury, which latter now has control of the Meteorological Office thru the newly constituted Meteorological Committee:

Letter from the Colonial Office to the Treasury.

DOWNING STREET,
5th August, 1905.

SIR: I am directed by Mr. Secretary Lyttelton to request you to inform the Lords Commissioners of the Treasury that as the result of an enquiry from the United States Weather Bureau for meteorological information with regard to Weihaiwei, he has had his attention drawn to the absence of any organization for the collection and publication of meteorological returns from the colonies generally, and for affording information to persons making enquiries as to climatic conditions in various parts of the British Empire.

It would appear that to a great extent in response to a circular of the 27th of July, 1895, the Meteorological Office receive a considerable amount of information, as shown in the enclosed print, which could with a little trouble be largely increased. Owing, however, to the want of the necessary clerical assistance most of these valuable returns serve

[1] Great Britain. Meteorological Office. First Report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury, for the year ended 31st March, 1906. London, 1906.

no useful purpose, although occasionally tables have been prepared by voluntary assistants, as in the case of the observations for tropical Africa recently classified by Mr. E. G. Ravenstein and officially published for the Meteorological Council.

I am to enclose for their Lordships' information a copy of the correspondence which has taken place on this subject, from which it would appear that the necessary collection and collation of returns, etc., could be done by a clerk at from £150 to £200 per annum under the supervision of the Meteorological Council. Mr. Lyttelton understands that the cost of printing and publication would amount to about the same sum, so that the total cost should not be more than from £300 to £400 per annum. This does not seem to be an excessive amount for the performance of work of such importance, both from an economic and from a purely scientific point of view. Mr. Lyttelton would therefore be glad if their Lordships could see their way to sanction the provision on the estimates for 1906–7 of a sum of money for this purpose.

I am to add that Mr. Lyttelton has been approached by the British Association with a proposal for a large scheme involving the creation of a separate office, but after due consideration he has decided that the proposal is not one that he can recommend to their Lordships.

I am, &c., C. P. LUCAS.

The Secretary to the Treasury.

This letter having been referred to the Meteorological Committee, Doctor Shaw as chairman of the committee, replied:

I am authorized by the Meteorological Committee to say that they concur in the opinion expressed by the Council and supported by the Secretary of State, that it is desirable to place upon an organized footing the collection and publication of meteorological statistics of those colonies and dependencies which have no separate meteorological organizations.

They further agree that the simplest method of dealing with the question would be for the Meteorological Office to be definitely charged with the duty of preparing for official publication an annual volume of meteorological statistics for the Crown colonies and dependencies, with such information about the publications of the meteorological organizations of India, Canada, Australia, and South Africa as would enable a reader to find his way to any information that is available about climatic conditions in various parts of the Empire.

The cost to the office involved in carrying out this suggestion would be represented by an appropriation of about £200 for clerical work, on the understanding that the general direction and supervision could be accepted without special provision. The cost of the printing, which does not fall upon the office grant, would be in addition to that sum. The cost of the recently published volume of observations in tropical Africa referred to in the letter from the Secretary of State for the Colonies is reported by the Stationery Office to have been nearly £46.

The committee have carefully considered the allocation of the meteorological grant in order to see whether, under the new conditions, they could find the means for this work, but they find that the maintenance of the work which the office has in hand already will absorb the funds at the disposal of the committee, so that the additional work could only be undertaken if some of the existing work were abandoned. Having regard to the various public interests involved, the committee do not see their way to any immediate modification of the general scheme of operations of the office, and they desire me to express their regret that they have been unable to set aside the necessary sum for the clerical work required for dealing with colonial meteorology in the estimates for the ensuing year.

Thus the meteorological records for some hundreds of thousands of square miles of the earth's surface, including many regions in which climate is a factor of capital importance in the great process of empire-building, still remain almost wholly inaccessible to climatologists.

At present the meteorological returns for a considerable number—in fact, a majority—of the British colonies are represented only by abstracts, of a rather meager description, published in the annual reports of the Colonial Office, the Army Medical Department, and the Board of Trade. Moreover, these voluminous publications, which contain an immense amount of statistical matter not of interest to the meteorologist, are to be found in but few scientific libraries.

A separate periodical publication devoted to the meteorology of the British Empire is a desideratum, and doubtless British meteorologists will eventually see their way to its realization. India, Canada, South Africa, Australia, New Zealand, Mauritius, Hongkong, and a few other colonies are already well provided for, but a large number of minor colonies and dependencies still need provision.

PUBLICATION OF CLIMATOLOGICAL RETURNS FOR THE BRITISH ISLES.

At present there are three bodies which collect and publish climatological data for the British Isles, viz, the Royal Meteorological Society, the Scottish Meteorological Society, and the Meteorological Office, besides the British Rainfall Organization, under the direction of Dr. H. R. Mill, which is the central institution for the collection of rainfall data. The publications of these bodies overlap to a considerable extent; moreover, they are not easily combined for the purposes of the climatologist who wishes to utilize all available material. The subject of initiating a joint system of collection and publication has recently engaged the attention of the Meteorological Committee, and a conference to this end has been held with representatives of the meteorological societies. It is expected that effective progress in the desired direction will have been made by the end of the present year.

CLIMATOLOGY IN THE "HANN-BAND."

From the special volume of the Meteorologische Zeitschrift,[2] issued to commemorate the completion by Doctor Hann of forty years' editorship of that journal, and made up of contributions from Hann's friends and colleagues thruout the world, we select for brief mention the following papers as coming especially within the scope of this column:

Schreiber, Paul. Untersuchung über die Genauigkeit der Tages-, Monats- und Jahresmittel aus den Temperaturbeobachtungen für die drei Stundenkombinationen: 6^a–2^p–10^p, 8^a–2^p–8^p und 7^a–2^p–9^p.

The stations of the Meteorological Institute of Saxony, of which Doctor Schreiber is director, originally made their observations at 6 a. m., 2 p. m., and 10 p. m. In 1883 the hours were changed to 8 a. m., 2 p. m., and 8 p. m.; and in 1901 the hours now generally used in Germany, viz, 7 a. m., 2 p. m., and 9 p. m. were adopted. The author compares the results obtained from these various combinations, with the true means for the year, month, and day, using as his standard a 17-year record, from a self-registering thermometer at Chemnitz. He finds that the first combination gives the best annual means, the second and third the best monthly means, and the first the best daily means. The least satisfactory daily mean is given by the third combination, i. e. (7 a. m. + 2 p. m., + 9 p. m. + 9 p. m.), ÷ 4; in individual cases it may depart as much as 4°C. from the true daily mean.

Augustin, Fr. Die Niederschläge in Prag.

The author compares the results of rainfall measurements at seven points in the city of Prague during the eight years 1897–1904. After reducing these records to a 50-year period, by comparison with observations at the astronomical observatory, he selects that of the Petrinwarte as representing the normal rainfall of the city. This gives Prague an annual rainfall of 529 mm., instead of the 455 mm. that is deduced from a record of over one hundred years at the astronomical observatory, where the exposure of the rain gage is quite unsatisfactory.

There are at present 14 rain gages in operation in Prague and its environs, 11 of which are equipped with self-recording apparatus.

Hepites, St. C. Les sécheresses en Roumanie.

Severe droughts having occurred in Roumania in 1899 and 1903–1904, certain writers were inclined to think that deforestation or some other agency had wrought a change in the climate. The author cites several early chronicles, etc., to show that equally severe droughts have occurred from early times.

Doctor Hepites is the Director of the Meteorological Insti-

[2] Meteorologische Zeitschrift. Haun-Band. Zum vierzigjährigen Redaktionsjubiläum J. Hann's von Freunden und Kollegen gewidmet. Braunschweig, 1906.

tute of Roumania, and the chief authority upon the climate of that country.

Danckelman, von. Die Niederschlagsverhältnisse des Schutzgebietes Togo.

Togo is the most backward of Germany's African protectorates in the matter of rainfall observations. However, in 1905 the rainfall stations numbered 20, of which 12 had been in operation at least four years, so that enough material was available to enable the author to draw some general conclusions.

All stations in Togo show a double period in the rainfall, with maxima in May or June, and August, September, or October; and minima in December, January, or February, and July, August, or September. The second dry period, however, becomes less and less pronounced as one goes north, so that in the northernmost part of the country (where observations have not yet been made) the two rainy seasons probably merge into one. The coast of Togo has a much lighter rainfall than other parts of the Guinea coast, and it is subject to great irregularities. These facts are attributed to the effect of ocean currents, and in order to investigate this theory regular observations of water temperature have been undertaken at Lome, the principal port of the protectorate.

Freiherr von Danckelman is especially interested in the climatology of the German colonies and protectorates, and devotes a great deal of attention thereto in the valuable Mitteilungen aus den deutschen Schutzgebieten, of which he is editor.

Mazelle, Eduard. Temperatur von Triest, nebst einem Beitrag zur Kenntnis des Temperaturunterschiedes Stadt–Land.

The observatory of Trieste, of which Professor Mazelle is Director, was recently moved from the center to the outskirts of the city. On the basis of a year of simultaneous observations at the old and new locations 30-year temperature normals have been computed for the latter. A comparison has also been made with four stations in the surrounding country. While the temperatures recorded at the old location were generally higher than at the country stations, the observatory in its present situation appears to register the natural temperature of this region quite satisfactorily.

Kremser, V. Über die Schwankungen der Lufttemperatur in Norddeutschland von 1851 bis 1900.

After a very careful examination of the temperature observations at some thirty stations, the author concludes that:

> The *temperature variability* in northern Germany and the *difference in temperature* between western and eastern Germany, during the second half of the nineteenth century, agree, in their fluctuations, both with each other and with the frequency of sun spots. They increase quite regularly until some time in the sixties, and then as regularly decrease to the end of the century.

The statement as to the temperature variability applies both to the change in temperature from one year to the next and to the departure of the mean temperature of each year from the assumed normal or mean of the whole series. The net result of the discussion is, therefore, that from 1850 onward the temperature of northern Germany was marked by rapid fluctuations and steep gradients, which reached their maximum in the decade 1861–1870; after which the distribution of temperature both in space and in time became more and more uniform to the end of the century; and that these fluctuations coincide with the march of sun-spot frequency (as obtained by the use of smoothed lustral mean values of the sun-spot relative numbers).

Other interesting papers bearing on climatology are contributed to the "Hann-Band" by Angot (general formula for the diurnal variation of temperature), S. Rona (discussion of the "kossava", a violent southeast wind of southern Hungary), Riggenbach (diurnal period of the rainfall at Basel), von Bezold (distribution of insolation), etc.

METEOROLOGICAL STATIONS IN THE GOLD COAST COLONY, WEST AFRICA.

The accompanying fig. 1 shows the location of the meteorological stations now in operation in the Gold Coast Colony, including its hinterland districts of Ashanti and the Northern Territories. Observations of temperature and rainfall are made at all these stations and the results are transmitted in manuscript to the Meteorological Office, London. A very brief résumé is published annually in the Colonial Reports. A fuller résumé for Accra appears in the annual Statistical Tables Relating to the British Colonies, etc., published by the Board of Trade. Monthly values of temperature and rainfall in 1903 at Accra, Cape Coast, and Kumasi, appeared in the Army Medical Reports for that year.

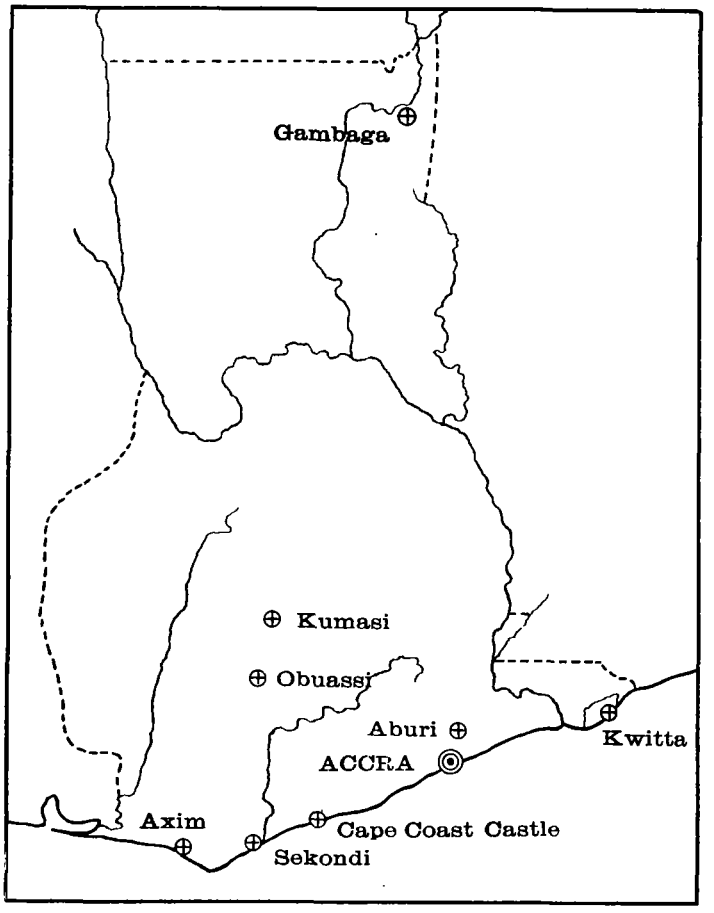

FIG. 1.—Meteorological stations in the Gold Coast Colony (including Ashanti and the Northern Territories).

Other points at which observations have been made are: Elmina and Christainsborg (temperature and pressure normals in Buchan's "Report on Atmospheric Circulation"); Begoro (rainfall values for one year in Supan's "Verteilung des Niederschlags"); Ada (rainfall observations in Colonial Reports, 1897–1898). Normals of pressure, temperature, humidity, rainfall, etc., from two early series of observations on the Gold Coast (Christiansborg, 1829–1842, and Fort Elmina, 1860–1862) appear in Meteorologische Zeitschrift, Bd. IX, 1874, pp. 42–45. (See also last paragraph *infra*.)

In addition to the references on the climate of the Gold Coast contained in Hann's "Klimatologie" the following will be found useful.

For the Gold Coast proper: George Macdonald's "The Gold Coast, Past and Present" (London, 1898), pp. 62–69.

For the Northern Territories: Col. H. P. Northcott's "Report on the Northern Territories of the Gold Coast", published by the Intelligence Division of the War Office (London, 1899), The last-named work contains brief series of observations, for parts of 1898, at Gambaga, Yabum, Bona, Wa, and Kintampo; also, for part of January, 1899, at Wa.

WEATHER BUREAU MEN AS EDUCATORS.

Mr. W. M. Wilson, Section Director, Ithaca, N. Y., informs us that he gave the usual course of instruction in meteorology and climatology during the latter half of the college year to a class of 23 students. Waldo's Elementary Meteorology and Hann's Climatology were used as text-books. As one of the regular courses of the college of agriculture of Cornell University, it consisted of three lectures each week (one hour each), with laboratory work in drawing weather maps, climatic charts, etc., and taking and recording weather observations. Practise forecasts were made during the latter part of the course from weather maps and from local observations.

The course was considered quite successful altho by no means satisfactory. The facilities for teaching meteorology are at present decidedly poor, but when the new agricultural building is completed, about July, 1907, a suitable laboratory and lecture room with lantern will be provided. There is considerable interest manifested in the subject, and it is stated by Professor Tarr, who has heretofore given a short course in meteorology in connection with the subject of physical geography, that he will withdraw this course for the coming year and advise students desiring instruction in meteorology to take the course offered by the college of agriculture. This action on his part should increase the class and stimulate the interest.

The collection of slides, charts, etc., for illustrative purposes is well under way and it is hoped to make the course in meteorology at Cornell for the coming year worthy of the institution with which it is connected.

Mr. Joseph L. Cline, Observer, Corpus Christi, Tex., reports that the Corpus Christi Board of School Directors and School Superintendent have requested him to deliver one lecture a week on meteorological and kindred subjects to the seniors and subseniors of the local high school during the scholastic year 1906–7; Mr. Cline has given such lectures during the past two years.

Mr. M. L. Fuller, Observer, Canton, N. Y., writes in regard to the elective course in meteorology conducted by him, now given for the first time in the first semester of the college year now opening at St. Lawrence University. As the electives for the first semester are chosen in the preceding spring, which in this case was before the students could know that meteorology would be offered, the difficulty of changing plans has doubtless operated to reduce the size of the class this year.

The announcement in the university catalog relative to the course is as follows:

Geology 7.—Meteorology.—I. Monday, Wednesday, and Friday, at 3 p. m.

This course emphasizes the practical aspects of the subject rather than the technical. The atmosphere is of prime importance in the economics of earth. It has performed a large share in the preparation of the soil; it has directly or indirectly determined to a great extent the growth, development, and distribution of vegetation, animal life, and man; it exerts an important influence upon the occupations, the energy, the prosperity, and enlightenment of peoples.

The movements of the atmosphere thru which it contributes to these results, and the laws governing the movements, were long unknown, but are now in a measure understood, and are being observed and studied thruout the world. The civilized nations are annually expending several million dollars in applying present weather knowledge for the benefit of commerce and the productive industries.

This modern science of meteorology is now offered as an elective in the junior and senior years. The course will cover the ground treated in Davis's elementary text and will include such general topics as—

The atmosphere: temperature, pressure, general circulation.
The moisture of the atmosphere: dew, frost, fog, clouds, rainfall.
General storms: hurricanes, cyclonic storms of temperate latitudes.
Local storms: thunderstorms, hailstorms, tornadoes.
The work of the United States Weather Bureau.
Weather forecasting: principles and practise.
The care and management of meteorological apparatus.
Frost: its formation, prediction, protection from.
Clouds: classification, movements, value in forecasting locally.
The practical application of meteorological knowledge.

The text will be supplemented by lectures, collateral reading, and laboratory work.

The laboratory work will include: the use of meteorological instruments; a series of individual weather observations; the construction of charts, diagrams, weather maps, etc.; weather forecasting.

The following lectures and addresses by Weather Bureau men are reported:

Mr. W. S. Belden of the Vicksburg, Miss., office, while on leave, August 22, 1906, before the Brown County Teachers' Institute, at Hiawatha, Kans., on "The Work of the Weather Bureau".

Mr. M. L. Fuller, of the Canton, N. Y., office, July 18 and 19, 1906, at the Iowa State Normal Summer School, Cedar Falls, Iowa, a special address to the physical geography classes; also two evening lectures, upon "The Weather of the United States and of Iowa" and "The Work of the Weather Bureau; Local Storms"; also July 23 and 24, at the Webster County Teachers' Institute, Fort Dodge, Iowa, the same two lectures.

Mr. H. W. Richardson, September 22, 1906, before the public school teachers and principals of Duluth, Minn., on "The Weather Bureau".

Mr. M. R. Sanford, August 1, 1906, before the professors and students of the Syracuse University Summer School, on "Weather Observations, Charts, and Forecasts".

Mr. J. Warren Smith of the Columbus, Ohio, office, August 22 and 23, 1906, before the Lake County Teachers' Institute at Painesville, Ohio, two lectures on "The Science of the Weather" and "The Daily Atmospheric Survey"; also August 28 and 29, at Cleveland, before the Cuyahoga County Teachers' Institute, the same lectures; also August 24, at Chardon, Ohio, before the Geauga County Teachers' Institute, the second of the lectures.

Mr. P. H. Smyth, September 3, 1906, before the Alexander County Teachers' Institute, at the Cairo, Ill., High School Building, on "U. S. Weather Bureau Forecasts and Warnings".

Mr. Edward L. Wells, August 9, 1906, before the Summer School and Teachers' Institute, at Boise, Idaho, on "Weather Forecasting".

We are glad to say that in some of these cases a slight compensation or honorarium has been granted to our men for their services, and we hope that in many other cases this action will be followed. Weather Bureau employees are paid only for their exacting official services; the extra labor involved in lecturing and teaching, and the special preparation incident thereto, is not imposed upon them as an official duty. Every employee may be relied upon to do what he can to promote the teaching and study of meteorology.—EDITOR.

EDUCATIONAL NOTES.

Prof. Willis I. Milham, of Williams College, Williamstown, Mass., has just published in pamphlet form a syllabus of his course in meteorology. He informs us that after using the syllabus a few years he "may begin to write it up as a text-book".

In the preface to the syllabus it is explained:

This syllabus is intended primarily for the students of Williams College where meteorology is given as a 3-hour elective course for juniors and